Module 2 - PC Assembly

2.0 Introduction

2.0.1.1 Welcome

Assembling computers is often a large part of an IT technician's job. You must work in a logical, methodical manner when working with computer components. At times, you might have to determine whether a component for a customer's computer needs to be upgraded or replaced. It is important that you develop skills in installation procedures, troubleshooting techniques, and diagnostic methods. This chapter discusses the importance of component compatibility. It also covers the need for adequate system resources to efficiently run the customer's hardware and software. Computers, computer components, and computer peripherals all contain hazards that can cause severe injury. Therefore, this chapter begins with general and fire safety guidelines to follow when working with computer components.

In this chapter, you will learn about PC power supplies and the voltages they provide to other computer components. You will learn about the components that are installed on the motherboard; the CPU, RAM, and various adapter cards. You will learn about different CPU architectures and how to select RAM that is compatible with the motherboard and the chipset. You will also learn about various types of storage drives and the factors to consider when selecting the appropriate drive.

It is important to not only learn about assembling computer components but also to build hands-on skills. In this chapter there are several labs where you will assemble a computer. Each of the labs have you progressively install components such as the power supply, CPU, RAM, drives, adapter cards, and cables until computer assembly is complete.

2.1.1 General and Fire Safety

2.1.1.1 Video Explanation - General and Fire Safety

Hello everyone, it's time to talk safety. Let's go over some guidelines in order to avoid cuts, burns, electrical shock and damage to your eyesight.

To start off we want to remove any watches or jewelry and also secure our loose clothing, done. We also need to make sure that we turn off and unplug any equipment before we work on it. A safe and usable work station is going to be a clean work station, so make sure you keep food and drinks and any clutter out of our workspace.

We also need to make sure that as we work inside of a computer case, that any sharp objects should be covered with tape. For your own safety, you should never open a power supply or a monitor that has a built-in power supply. And while we work it's very important to wear safety goggles to prevent damage to your eyesight.

When you go to lift those heavy computer towers, printers, servers and more, make sure that you bend your knees when you lift heavy objects to avoid injuring your back. As we work with electrical and dangerous components, you never know when something might catch fire. You should always know where the closest fire extinguisher is and also how to use it.

As we discuss fire safety, it's important that you remember to never fight a fire that is out of control or not contained. You should make sure you know how to get out of the building quickly that you are in. And don't forget to contact emergency services for help. Make sure you're prepared. You should locate and read instructions on any fire extinguisher near your workspace before you use them. Also you should make sure that the fire extinguisher is going to work.

For example, this fire extinguisher no longer is ready to work, it needs a recharge. Now a fire can spread very quickly and also be very costly. You should know the basics of using a fire extinguisher to prevent a small fire from getting out of control.

The word you have to remember is pass. P stands for pull the pin. A stands for aim at the base of the fire. Not at the flames. S stands for squeeze the lever. S stands for sweep the nozzle from side to side.

You should be familiar with the different types of fire extinguishers. Some fire extinguishers, they're actually designed for paper, wood, plastics and cardboard. While others are designed for electrical equipment or even gasoline or combustible metals. This fire extinguisher here is rated for a couple items. It's rated for trash, wood and paper. It's rated for liquids, grease and it's rated for electrical.

Let's take a look at my fire extinguisher in action.

2.1.2 Open the Case and Connect the Power Supply

2.1.2.1 Video Demonstration - Install the Power Supply

Hello everyone. We've got our PC desktop tower here. We're going to open this thing up and get started in the installation of a power supply.

I've got my anti-static mat down and I've got my anti-static wrist drop connected to it so we're going to be good to go to get started.

So, I'm going to take this computer tower and we're going to place it on its face. Put it face side down and by doing this what we're going to see here on the back is going to be this huge slot. This is our power supply slot. And right now we've got nothing there so there is where we're going to install our power supply which we have ready for us sitting on our mat.

To start, step one is to open the right side cover of the computer case. So I'm going to put this thing back down on its right side and I'm going to use my Torx screwdriver to unscrew this screw holding on this computer case. I'll slide off the cover and we'll be able to take a look at the inside of our computer tower.

Now at this point in time we have an empty computer tower. We have nothing installed at the moment. All we have are some USB and audio headers attached to the front of the case. If I put the case front side down, we can view these adaptor card slots here right above the power supply slot on the back.

Our power supply unit, known as a PSU, that's what we're about to install. So let's chat about the PSU. Now, right now, with this PSU it's at so many watts. This is a 450 watt power

supply and on this PSU it is currently set to a 115 volts, the U.S. standard. If you look closely at the PSU, we can actually take a look at more details of it, including form factor for the PSU but that's not for us at this moment.

Now for us, make sure you plan ahead and choose the correct power supply unit for your computer build especially if your CPU and choice of graphics card are going to pull a lot of power. Now step two, we need to align the screw holes of our power supple with this power supply slot. So we have the power supply slot here, I'm going to take my power supply and put it into place and we can take a look at those screw holes. They're about to line up and see if we can lock this in. Now my case is really cool because it actually has a locking mechanism. I can let go of the power supply. My screw holes are aligned and it is currently locked into place.

Now we need to take the action of screwing it in. If you look closely, you'll see those screw holes are currently lined up. And we can even get a closer view based off of my camera. There we go. So we want to do now is lock those screws into place. So I'll take four of my power supply screws and we get to put this thing in and be done. All four screws are installed. The power supply is not going anywhere. Hopefully you chose the correct wattage for your internal parts otherwise you'll be switching this out in the very near future. Thanks for watching our power supply install.

2.1.2.3 Select the Case and Fans

The choice of motherboard and external components influences the selection of the case and power supply. The motherboard form factor must be matched with the correct type of computer case and power supply. For example, an ATX motherboard requires both an ATX-compatible case and power supply.

You can select a larger computer case to accommodate additional components that may be required in the future. Or you might select a smaller case that requires minimal space. In general, the computer case should be durable, easy to service, and have enough room for expansion.

Cases often come with a power supply preinstalled. In this situation, you still need to verify that the power supply provides enough power to operate all the components that will be installed in the case.

A computer has many internal components that generate heat while the computer is running. Case fans should be installed to move cooler air into the computer case while moving heat out of the case. When choosing case fans, there are several factors to consider as described in the following table.

Note: The direction of air flow created by all the fans in the case must work together to inject cooler air and expel hotter air. Installing a fan backwards or using fans with the incorrect size or speed for the case can cause the air flows to work against each other.

Factors to Consider when Choosing a Case Fan

Factors	Consider ….
Case size	Larger cases often require larger fans because smaller fans cannot create enough air flow.
Fan speed	Larger fans can spin more slowly than smaller fans, which reduces fan noise.
Number of components	Multiple components in a computer create additional heat, which requires more fans, larger fans, or faster fans.
Physical environment	The case fans must be able to disperse enough heat to keep the interior of the case cool.
Number of mounting places available	Different cases have different numbers of mounting places for fans.
Location of mounting places available	Different cases have different locations for mounting fans.
Electrical connections	Some case fans are connected directly to the motherboard, while others are connected directly to the power supply.

2.1.2.4 Select a Power Supply

Power supplies convert AC input to DC output voltages. Power supplies typically provide voltages of 3.3V, 5V, and 12V, and are measured in wattage. The power supply must provide enough power for the installed components and allow for other components that may be added at a later time. If you choose a power supply that powers only the current components, you might need to replace the power supply when other components are upgraded.

The table below describes various factors to consider when selecting a power supply.

Be careful when connecting the power supply cables to other components. If you have a difficult time inserting a connector, try repositioning it, or check to make sure that there are no bent pins or foreign objects in the way. If it is difficult to plug in a cable or other part, something is wrong. Cables, connectors, and components are designed to fit together snugly. Never force a connector or component. If a connector is plugged in incorrectly, it can damage the plug and the connector. Take your time and make sure that you are connecting the hardware correctly.

Note: Make sure to select a power supply with the proper connectors for the types of devices to be powered.

Factors to Consider when Choosing a Power Supply

Factors	Consider ….

Type of Motherboard	The power supply must be compatible with the motherboard.
Required Wattage	Add the wattage for each component. If the wattage is not listed on a component, calculate it by multiplying its voltage and amperage. If the component requires different levels of wattage, use the higher requirement.
Number of components	Make sure the power supply provides enough wattage to support the number and types of components plus another 25% at a minimum.
Type of components	Make sure the power supply provides the right types of power connectors.
Type of case	Make sure the power supply can be mounted in the desired case.

2.1.2.5 Lab - Install the Power Supply

Introduction

In this lab, you will install a power supply in a computer case.

Recommended Equipment

- Power supply with a compatible form factor to the computer case
- Computer case
- Tool kit
- Power supply screws

Instructions

Step 1: Open the Computer Case.

a) Remove the screws from the side panels.
b) Remove the side panels from the computer case.

Step 2: Install the Power Supply.

a) Align the screw holes in the power supply with the screw holes in the case.
b) Secure the power supply to the case with the power supply screws.
c) If the power supply has a voltage selection switch, set this switch to match the voltage in your area.

Questions:

What is the voltage in your area?

How many screws secure the power supply in the case?

What is the total wattage of the power supply?

d) This lab is complete. Please ask the instructor to verify your work.

2.1.3 Install the Motherboard Components

2.1.3.1 Video Demonstration - Install the CPU

We're going to install a CPU, central processing unit, into our motherboard. Here is an exercise that is not commonly done in the classroom. We're going to take a CPU, like this chip here, and we're going to install it into our motherboard slot.

Now, what we must do is orient the CPU. Step one is locating pin one. Pin one is usually what indicates how the CPU orientation should work. We have a triangle, which we'll be able to see, right here, let me zoom in. And this triangle, is what's going to inform us of the alignment of pin one.

Now, if we go to our motherboard, and we open up our motherboard slot. If we look closely, what we'll be able to see here as well is that same triangle marking. And that triangle marking is right here, where it shows us the orientation for our CPU.

Now, our CPU also has a keyed slot on it, and on the CPU on the motherboard housing, you'll also be able to see here that we'll be dropping the CPU in those keyed slots to ensure that it's correctly aligned. Now that we know how it should be aligned, step two, is to safely lower the CPU into the CPU slot. For step three, we can lower the CPU housing and lock the lever into place to hold our CPU firmly in place. For step four, it is important that we take some thermal paste, and we're going to place a pea-sized drop, carefully, on the top center of our CPU. This thermal paste will help the distribution of heat from the CPU to the heat sink that we will install next. Now to keep this CPU cool and prevent it from overheating, we are going to install a heat sink for step five.

These commonly have a fan attached to them, but not all of them do. These fins we see here are going to absorb the heat from the CPU and have slots for airflow to move in between. The fan on top of the heat sink will help draw the heat away and cool the fins. This will allow them to absorb more heat from the CPU. As we attempt to place the heat sink on the motherboard, it may take one to two attempts to position it correctly over the screws that are going to surround our CPU. The final step, step six, is to screw down the heat sink.

After positioning the heat sink correctly, so that it aligns with the heat sink screws on the motherboard, we will screw in the four screws in a specific order. It is best to screw one corner first, and then go to the opposite corner, diagonally from it. This will help ensure we have a flushed connection between the CPU and thermal paste and the heat sink. As I mentioned, we'll go diagonally across to the other corner.

Now we can continue on the last two screws. Now that all four screws are locked in, the heat sink will not be able to move or shift at all. Having a tight and flushed fitting will also allow the CPU to better stay cool. Thanks for watching our CPU install.

2.1.3.3 Video Demonstration - Install the RAM

Hello, everyone. At this point in time we have our power supply installed in our case. We also have our heat sink installed on top of our CPU, which is locked into the motherboard.

Now, before we move this entire setup into our computer case, we will install the RAM modules. These are the RAM modules. It is much easier to install these now than after we have this entire setup screwed into the case.

On the motherboard, we have two slots to add RAM. Take note of where the notches are on the RAM slots on our motherboard, right here and right here. These notches will line up with the notches on our RAM.

Step one is to open the levers on the RAM slots of the motherboard. We're going to open them as far as they will go. They will click into place. This will require almost no force.

Step two is we're going to line up the RAM module in the correct direction for the slot and that notch.

Step three, we're going to slowly lower the RAM module into the slot.

Step four, now use your thumb to press down on both sides of the RAM module, you'll feel the RAM module be locked in by the two lever arms on the motherboard.

Next, we take the second RAM module, we will verify the alignment again based on the notches on the motherboard RAM slot, and we'll press the RAM module down vertically using both of our thumbs again. You're going to push downward using your thumb on the left, and on the right, as it clicks in, now the RAM modules are installed.

This is exciting. Proceed onward in the course. We're almost ready to put this motherboard into the computer case.

2.1.3.5 Video Demonstration - Install the Motherboard

Hello everyone. Can you believe it? We're going to install the motherboard with the CPU, heat sink, and RAM into our computer case.

Before we just place the motherboard in the computer case and call it a day, we first need to install the standoffs into our computer case. These standoffs will be used to secure the motherboard in place within the computer case. Some computer cases will have built-in standoffs like mine, for example.

Others, you'll have to take each standoff and install it yourself. These standoffs are commonly small, and you'll screw it in using the adaptor that comes with the standoffs. In order to locate the standoff locations, it is best to take your motherboard and practice placing it into your computer case.

Step one is to align the motherboard in the correct direction by having our adaptor forks facing out of the back of the computer case. So we'll take our motherboard. The motherboard is resting in the case.

Step two is to locate the exact standoffs that are needed by looking at the screw hole locations. You take a close look at it, you can shift the motherboard, and we'll be able to find the exact screw hole locations that'll be needed.

Step three is to remove the motherboard and then screw in the standoffs at the correct locations. Since my computer case does not require this step, we're going to continue on. Assuming you've installed your standoffs, step four is to take our I/O plate, input/output adapter plate, and align it on the back of our computer case. This will provide adequate dust and airflow for our computer case.

Let's position the I/O adapter plate with the writing and ports in the correct direction. If you install the I/O adapter plate upside down, the motherboard won't be able to fit correctly. So make sure that it's correct. As you put the plate into place, give it a push in each corner and along the edges, and you'll hear it snap into place. Take your time on this step as some adapter plates are plastic while others are metal, they are possible to bend and/or break.

Now that the plate is installed, put the computer case back on its side for step five. Lowering the motherboard into place. Let's finish installing the motherboard. The key of installing the motherboard is to put it into the case at the correct angle. As we place it in, we need to align the I/O ports of the motherboard with the slots of the I/O plate. If I pick up the case, we should be able to see it resting nicely.

At this time, we can use our screwdriver for step six, installing the screws into the motherboard standoffs. One by one, we will install the motherboard screws. Make sure not to install the screws too tight as you don't want to crack the motherboard through excessive force. Don't worry about the screws being not overly tightened, as we have a good amount of screws to keep this motherboard in place.

If you choose to upgrade your CPU or heat sink in the future, some gaming and high performance heat sinks actually require you remove the motherboard install special plate to the back. Let's get started installing those screws.

Now that all the screws are tightened, we are good to finish our build and continue onto the next video. Who knows, you might be removing your motherboard and installing it again in the future. Get your practice with us here for installing a motherboard into a computer case.

2.1.3.7 Select the Motherboard

New motherboards often have new features or standards that may be incompatible with older components. When you select a replacement motherboard, make sure that it supports the CPU, RAM, video adapter, and other adapter cards. The socket and chipset on the motherboard must be compatible with the CPU. The motherboard must also accommodate the existing heat sink and fan assembly when reusing the CPU. Pay particular attention to the number and type of expansion slots. Make sure that they match the existing adapter cards and allow for new cards that will be used. The existing power supply must have connections that fit the new motherboard. Finally, the new motherboard must physically fit into the current computer case.

When building a computer, choose a chipset that provides the capabilities that you need. For example, you can purchase a motherboard with a chipset that enables multiple USB ports, eSATA connections, surround sound, and video.

The CPU package must match the CPU socket type. A CPU package contains the CPU, connection points, and materials that surround the CPU and dissipate heat.

Data travels from one part of a computer to another through a collection of wires known as the bus. The bus has two parts. The data portion of the bus, known as the data bus, carries data between the computer components. The address portion, known as the address bus, carries the memory addresses of the locations where data is read or written by the CPU.

The bus size determines how much data can be transmitted at one time. A 32-bit bus transmits 32 bits of data at one time from the processor to RAM, or to other motherboard components, while a 64-bit bus transmits 64 bits of data at one time. The speed at which data travels through the bus is determined by the clock speed, measured in MHz or GHz.

PCI expansion slots connect to a parallel bus, which sends multiple bits over multiple wires simultaneously. PCI expansion slots are being replaced with PCIe expansion slots that connect to a serial bus, which sends one bit at a time at a much faster rate.

When building a computer, choose a motherboard that has slots to meet your current and future needs.

2.1.3.8 Select the CPU and CPU Cooling

Before you buy a CPU, make sure that it is compatible with the existing motherboard. Manufacturers' websites are a good resource to investigate the compatibility between CPUs and other devices. The following tables list the various Intel and AMD sockets available and their supported processors.

Intel Sockets

Intel Socket	Architecture
775	LGA
1155	LGA
1156	LGA
1150	LGA
1366	LGA
2011	LGA

AMD Sockets

AMD Socket	Architecture
AM3	Pin Grid Array (PGA)
AM3+	PGA
FM1	PGA
FM2	PGA
FM2+	PGA

The speed of a modern processor is measured in GHz. A maximum speed rating refers to the maximum speed at which a processor can function without errors. Two primary factors can limit the speed of a processor:

- **Transmission Delay** - The processor chip is a collection of transistors interconnected by wires. Transmitting data through the transistors and wires creates delays.
- **Heat Generation** - As the transistors change state from on to off or off to on, a small amount of heat is generated. The amount of heat generated increases as the speed of the processor increases. When the processor becomes too hot, it begins to produce errors.

The front-side bus (FSB) is the path between the CPU and the Northbridge. It is used to connect various components, such as the chipset, expansion cards, and RAM. Data can travel in both directions across the FSB. The frequency of the bus is measured in MHz. The frequency at which a CPU operates is determined by applying a clock multiplier to the FSB speed. For example, a processor running at 3200 MHz might be using a 400 MHz FSB. 3200 MHz divided by 400 MHz is 8, so the CPU is eight times faster than the FSB.

Processors are further classified as 32-bit and 64-bit. The primary difference is the number of instructions that can be handled by the processor at one time. A 64-bit processor processes more instructions per clock cycle than a 32-bit processor. A 64-bit processor can also support more memory. To utilize the 64-bit processor capabilities, ensure that the operating system and applications installed support a 64-bit processor.

The CPU is one of the most expensive and sensitive components in the computer case. The CPU can become very hot; therefore most CPUs require an air-cooled or liquid cooled heat sink, combined with a fan for cooling.

The following table lists several factors to consider when choosing a CPU cooling system.

Choosing a CPU Cooling System

Factors	**Consider ….**
Socket type	The heat sink or fan type must match the socket type of the motherboard.
Motherboard physical specifications	The heat sink or fan must not interfere with any components attached to the motherboard.
Case size	The heat sink or fan must fit within the case.
Physical environment	The heat sink or fan must be able to disperse enough heat to keep the CPU cool in warm environments.

2.1.3.9 Select the RAM

New RAM may be needed when an application locks up or the computer displays frequent error messages. When selecting new RAM, you must ensure that it is compatible with the current motherboard. Memory modules are commonly purchased in matched capacity pairs to support dual channel RAM that can be accessed at the same time. Also, the speed of the new RAM must be supported by the chipset. It may be helpful to take written notes about the original memory module when you shop for the replacement RAM.

Memory may also be categorized as unbuffered or buffered:

- **Unbuffered memory** – This is regular memory for computers. The computer reads data directly from the memory banks making it faster than buffered memory. However, there is a limit on the amount of RAM that can be installed.

- **Buffered memory** – This is specialized memory for servers and high-end workstations that use a large amount of RAM. These memory chips have a control chip built into the module. The control chip assists the memory controller in managing large quantities of RAM. Avoid buffered RAM for a gaming computer and the average workstation because the extra controller chip reduces RAM speed.

2.1.3.10 Lab - Install the Motherboard in a Computer

Introduction

In this lab, you will install a CPU, a heat sink/fan assembly, and RAM module(s) on the motherboard. You will then install the motherboard into the computer case.

Recommended Equipment

- Computer case with power supply installed
- Motherboard
- CPU
- Heat sink/fan assembly
- Thermal compound
- RAM module(s)
- Motherboard standoffs and screws
- Antistatic wrist strap and antistatic mat
- Tool kit
- Motherboard manual

Instructions

Step 1: Install the CPU.

a. Place the motherboard, the CPU, the heat sink/fan assembly, and the RAM module on the antistatic mat.

b. Put on your antistatic wrist strap and attach the grounding cable to the antistatic mat.

c. Locate Pin 1 on the CPU. Locate Pin 1 on the socket.

Note: The CPU may be damaged if it is installed incorrectly.

d. Align Pin 1 on the CPU with Pin 1 on the socket.

e. Place the CPU into the CPU socket.

f. Close the CPU load plate and secure it in place by closing the load lever and moving it under the load lever retention tab.

g. Apply a small amount of thermal compound to the CPU.

Note: Thermal compound is only necessary when it is not included on the heat sink. Follow all instructions provided by the manufacturer for specific application details.

h. Align the heat sink/fan assembly retainers with the holes in the motherboard around the CPU socket.

i. Place the heat sink/fan assembly onto the CPU and the retainers through the holes in the motherboard.

j. Tighten the heat sink/fan assembly retainers to secure it.

k. Plug the fan connector into the motherboard. Refer to the motherboard manual to determine which set of fan header pins to use.

Step 2: Install the RAM.

a. Locate the RAM slots on the motherboard. Questions:

In what type of slot(s) will the RAM module(s) be installed?

How many notches are found on the bottom edge of the RAM module?

b. Align the notch(es) on the bottom edge of the RAM module to the notches in the slot.

c. Press down until the side tabs secure the RAM module.

d. Ensure that none of the RAM module contacts are visible. Reseat the RAM module if necessary.

e. Check the latches to verify that the RAM module is secure.

f. Install any additional RAM modules using the same procedure.

Step 3: Install the Motherboard.

a. Install the motherboard standoffs.

b. Install the I/O connector plate in the back of the computer case

c. Align the connectors on the back of the motherboard with the openings in the back of the computer case.

d. Place the motherboard into the case and align the holes for the screws with the stand-offs. You may need to adjust the motherboard to line up the holes for the screws.

Attach the motherboard to the case using the appropriate screws. This lab is complete. Please have the instructor verify your work.

2.1.4 Install Internal Drives

2.1.4.1 Video Demonstration - Install the Drives

Hello everyone, in this video, we get to install some drives. We're going to focus specifically on a hard disk drive and an optical disk drive.

Now first, we have the hard drive. Now this is an adaptor, it’s not actually a full hard drive, it’s a three and a half inch hard drive adaptor. And the reason this is important is because people commonly like to purchase these type of drives. These are solid states, they come in a two and a half inch side which is meant for a laptop.

With adapters like this, we can easily take a solid state hard drive, drop it into position, and close the lever. As we close it, now the two and a half inch drive is in a three and a half inch adapter. With this being done we could easily just slide this into our computer case and do the install of our screws.

Now for my computer case, it accepts both a two and a half inch and three and a half inch drive so I don't need to require an adapter for my case. But at this point in time, we can take our two and a half inch solid state drive, and we're going to install it into our case. When I line it up with the two screws, which you'll be able to see there's many different screw holes on the side of these we need align it up perfectly with a set of the holes.

Now for me, my two and a half inch hard drive fits beautifully right here. And then I can do my second screw. And now my two and a half inch solid state hard drive is installed.

After this, we want to install the optical disk drive. First, we need to make sure our front panel of our case has been removed. The front panel of the case is right here. And this is the slot where we're going to install our optical disk drive.

Now the first thing we need to do is remove this front panel because it’s in the way for us to actually be able to access the optical disk drive. Here we have these levers that we can actually pull out. And every case will be a little bit different. It will have some types of snaps or levers. And I can remove that front panel.

Now with it removed, if I put it on its back again, take a look at that. We have this bay here where we can slide in our optical disk drive. Now, as you slide the optical disk drive in, please make sure it’s facing the correct orientation. That is extremely important, we'd hate to have to turn the tower upside down every time we want to use the drive.

Now with my case, the drive locks in using a lever mechanism as I slid it in. As you saw previously with the power supply, this will hold it in place. So then just place our screws to lock it in. Which we'll do now.

Awesome. Next, we'll continue on with installing adapter cards to provide our computer top with even more functionality.

2.1.4.2 Select Hard Drives

You may need to replace an internal storage device when it no longer meets your customer’s needs, or it fails. Signs that an internal storage device is failing might be unusual noises, unusual vibrations, error messages, or even corrupt data or applications that do not load.

Factors to consider when purchasing a new hard disk drive are listed in the figure.

Internal drives usually connect to the motherboard with SATA while external drives connect with USB, eSATA, or Thunderbolt. Legacy motherboards may only offer the IDE or EIDE interface. When selecting a HDD, it is important to choose one that is compatible with the interfaces offered by the motherboard.

Most internal HDDs are available in the 3.5 inch (8.9 cm) form factor, however 2.5 inch (6.4 cm) drives are becoming popular. SSDs are generally available in the 2.5 inch (6.4 cm) form factor.

Note: SATA and eSATA cables are similar but they are not interchangeable.

New Hard Drive Factors

- Internal or external
- HDD, SSD, or SSHD
- Hot-swappable
- Heat generation
- Noise generation
- Power requirements

2.1.4.3 Select Optical Drives

Factors to consider when purchasing an optical drive are listed:

New Optical Drive Factors

- Connector type
- Reading capability
- Writing capability
- Optical media type

The following table summarizes optical drive capabilities.

DVDs hold significantly more data than CDs and Blu-ray discs (BD) store significantly more data than DVDs. DVDs and BDs can also have dual layers for recording data, essentially doubling the amount of data that can be recorded on the media.

Optical Drive Capabilities

Optical Device	Read CD	Write CD	Read DVD	Write DVD	Read Blu-ray	Write Blu-ray	Rewrite Blu-ray
CD-ROM	Yes	No	No	No	No	No	No
CD-RW	Yes	Yes	No	No	No	No	No
DVD-ROM	Yes	No	Yes	No	No	No	No
DVD-RW	Yes	Yes	Yes	Yes	No	No	No
BD-ROM	Yes	No	Yes	No	Yes	No	No
BD-R	Yes	Yes	Yes	Yes	Yes	Yes	No
BD-RE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

2.1.4.4 Install the Hard Drive

A computer case holds drives in drive bays. The following describes the three most common types of drive bays.

Types of Drive Bays

Drive Bay Width	Description
5.25 in. (13.34 cm.)	• Commonly used for optical drives. • Most full-size tower cases will have two or more bays.
3.5 in. (8.9 cm.)	• Commonly used for 3.5 inch HDDs. • Provide additional USB ports or smart card readers. • Most full-size tower cases will have two or more internal bays.
2.5 in. (6.35 cm.)	• Intended for smaller 2.5 inch HDDs and SSDs. • Smallest width bay. • Becoming increasing popular in newer cases.

To install an HDD, find an empty hard drive bay in the case that will accommodate the width of the drive, as shown in the figure. Smaller drives can often be installed in wider drive bays using special trays or adapters.

When installing multiple drives in a case, it is recommended to maintain some space between the drives to help airflow and enhance cooling. Also, mount the drive with the metal side face up. This metal face helps to dissipate heat from the hard drive.

Installation Tip: Slightly hand-tighten all the screws before tightening any of them with a screw driver. This will make it easier to tighten the last two screws.

2.1.4.5 Install the Optical Drive

Optical drives are installed in 5.25 inch (13.34 cm.) drive bays that are accessed from the front of the case. The bays allow access to the media without opening the case. In new installations, the bays are covered with a plastic insert that keeps dust from entering the case. Remove the plastic cover prior to mounting the drive.

To install an optical drive, follow these steps:

Step 1. From the front of the case, choose the drive bay that you want to hold the drive. Remove the faceplate from that bay if necessary.

Step 2. Position the optical drive so that it aligns with the 5.25 inch (13.34 cm.) drive bay opening at the front of the case, as shown in the figure.

Step 3. Insert the optical drive into the drive bay so that the optical drive screw holes align with the screw holes in the case.

Step 4. Secure the optical drive to the case using the proper screws.

Installation Tip: Slightly hand-tighten all the screws before tightening any of them with a screw driver. This will make it easier to tighten the last two screws.

2.1.4.7 Lab - Install the Drives

Introduction

In this lab, you will install the hard disk and optical drives.

Recommended Equipment

- Computer case with power supply and motherboard installed
- Antistatic wrist strap and antistatic mat
- Tool kit
- Hard disk drive
- Hard disk drive screws
- Optical drive
- Optical drive screws
- Motherboard manual

Instructions

Step 1: Install the Hard Disk Drive.

a. Align the hard disk drive with the 3.5 inch drive bay.

b. Slide the hard disk drive into the bay from the inside of the case until the screw holes line up with the holes in the 3.5 inch drive bay.

c. Secure the hard disk drive to the case using the proper screws.

Step 2: Install the Optical Drive.

Note: Remove the 5.25 inch cover from one of the 5.25 inch external drive bays if necessary.

a. Align the optical drive with the 5.25 inch drive bay.

b. Insert the optical drive into the drive bay from the front of the case until the screw holes line up with the holes in the 5.25 inch drive bay and the front of the optical drive is flush with the front of the case.

Secure the optical drive to the case using the proper screws. This lab is complete. Please have the instructor verify your work.

2.1.5 Install the Adapter Cards

2.1.5.1 Video Demonstration - Install the Adapter Cards

Hello everyone, in this video we need to install adapter cards. So first what you want to do, is take a look at our case and we need to take a look at what adapter slots we have.

Inside of my case we need to take a look at the motherboard in closer up. We have a PCIe x16, then we have three PCIe x1. So what we want to do is be able to pick out adapter cards that are going to be compatible with these PCI express slots.

Also, if you're wondering what this is, this is a mini PCI express. Think of wireless cards that you'll be able to install on a desktop tower.

So let’s get started. Step one, we're going to need to find an empty slot. Which we have, right here. So what you need to do, is take off the corresponding cover that covers that slot. To remove this cover which is covering this slot, I have to lift up my tower and we'll take a look at what I need to do on the outside. This screw here is holding on to those adapter card slot covers and keeps them in place. So I can go ahead and I unscrew that with a special Torx Screwdriver.

With that screw out, we can actually take this cover and just lift off and that exposes all of the adapter card slot covers at this time, I can actually take out this cover, and there's a lift off, I can remove it from the computer case.

Now the adapter slot cover is exposed and we're able to zoom back in and continue on. With that slot cover exposed, we can now install a PCIe x16 card, I happen to have. A PCI express graphics card, it's a PCIe x16, which we have here which is the physical compatibility that matches that slot.

Step two, I'm going to align the video card into the appropriate slot in the mother board, which will be right there.

For step three, we need to press down gently on this card to install it into place.

Step four, we need to reinstall that slot cover. I will put my slot cover back on and we will take our screw on our screw driver and we'll screw it back into place.

Thank you for watching, our adapter card is now installed.

2.1.5.2 Select Adapter Cards

Many of the functions of the hardware of a computer are found onboard the motherboard, such as audio, USB, or network connection. Adapter cards, also called expansion cards or add-on cards, are designed for a specific task and add extra functionality to a computer. They can also be installed when an onboard function has failed. There are a variety of adapter cards available that are used to expand and customize the capability of a computer.

The following list provides an overview of expansion cards that may be upgraded:

- **Graphics card** - The type of graphics card installed affects the overall performance of a computer. For example, a graphics card that needs to support intensive graphics could be RAM intensive, CPU intensive, or both. The computer must have the slots, RAM, and CPU to support the full functionality of an upgraded graphics card. Choose the graphics card based on current and future needs. For example, to play 3D games, the graphics card must meet or exceed the minimum requirements. Some GPUs are integrated into the CPU. When the GPU is integrated into the CPU, there is no need to purchase a graphics card unless advanced video features, such as 3D graphics, or very high resolution are required.
- **Sound card** - The type of sound card installed determines the sound quality of your computer. A computer system must have quality speakers and a subwoofer to support the full functionality of an upgraded sound card. Choose the correct sound card based on your customer’s current and future needs. For example, if a customer wants to hear a specific type of surround sound, the sound card must have the correct hardware decoder to reproduce it. In addition, the customer can get improved sound accuracy with a sound card that has a higher sample rate.
- **Storage controller** - Storage controllers can be integrated or added as an expansion card. They allow for the expansion of internal and external drives for a computer system. Storage controllers, such as RAID controllers, can also provide fault tolerance or increased speed. The amount of data and the level of data protection needed for the customer influences the type of storage controller required. Choose the correct storage controller based on your customer’s current and future needs. For example, if a customer wants to implement RAID 5, a RAID storage controller with at least three drives is needed.

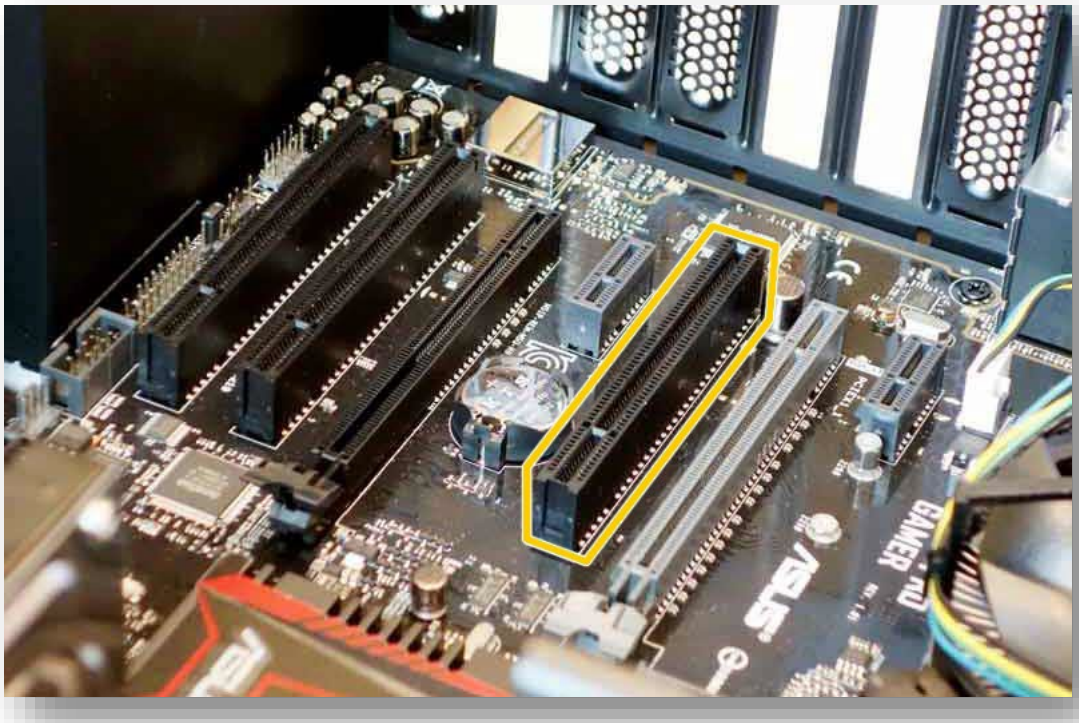
- **I/O card** - Installing an I/O card in a computer is a fast and easy way to add I/O ports. USB are some of the most common ports to install on a computer. Choose the correct I/O card based on your customer's current and future needs. For example, if a customer wants to add an internal card reader, and the motherboard has no internal USB connection, a USB I/O card with an internal USB connection is needed.
- **NIC** - Customers often upgrade a network interface card (NIC) to get wireless connectivity or to increase bandwidth.
- **Capture card** - A capture card imports video into a computer and records it on a hard drive. The addition of a capture card with a television tuner allows you to view and record television programming. The computer system must have enough CPU power, adequate RAM, and a high-speed storage system to support the capture, recording, and editing demands of the customer. Choose the correct capture card based on your customer's current and future needs. For example, if a customer wants to record one program while watching another, either multiple capture cards or a capture card with multiple TV tuners must be installed.

Adapter cards are inserted into two types of expansion slots on a motherboard:

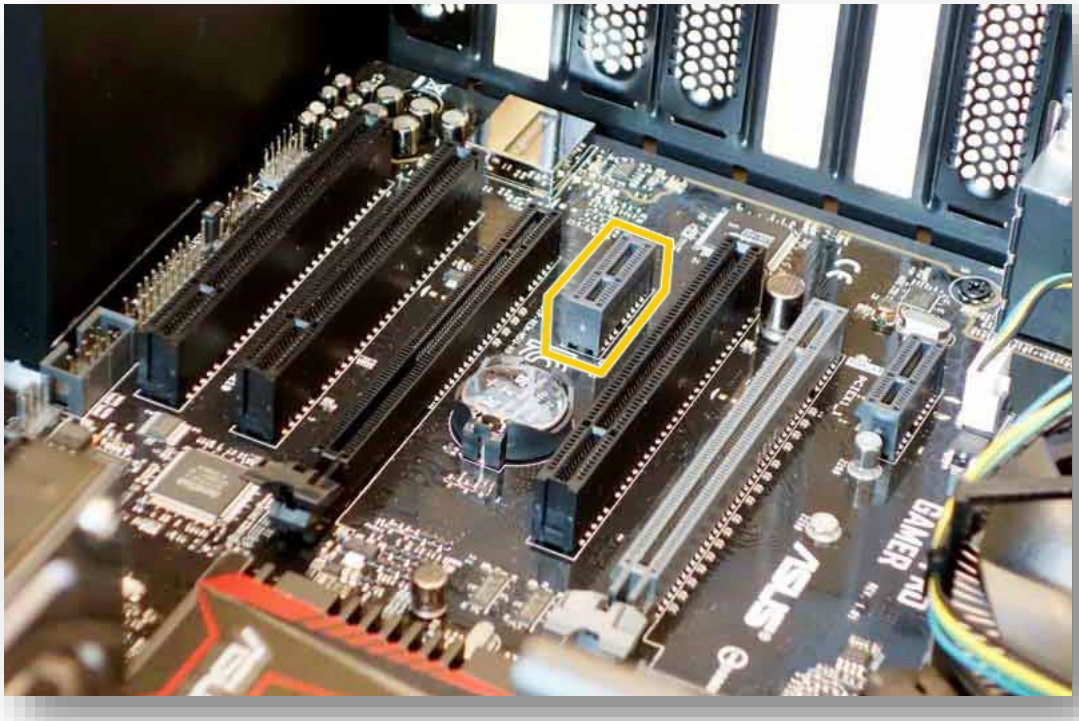
- **Peripheral Component Interconnect (PCI)** – PCI is commonly available to support older expansion cards.
- **PCI Express (PCIe)** – PCIe has four types of slots; x1, x4, x8, and x16. These PCIe slots vary in length from shortest (X1) to longest (x16) respectively.

Note: If the motherboard does not have a compatible expansion slot, an external device may be an option.

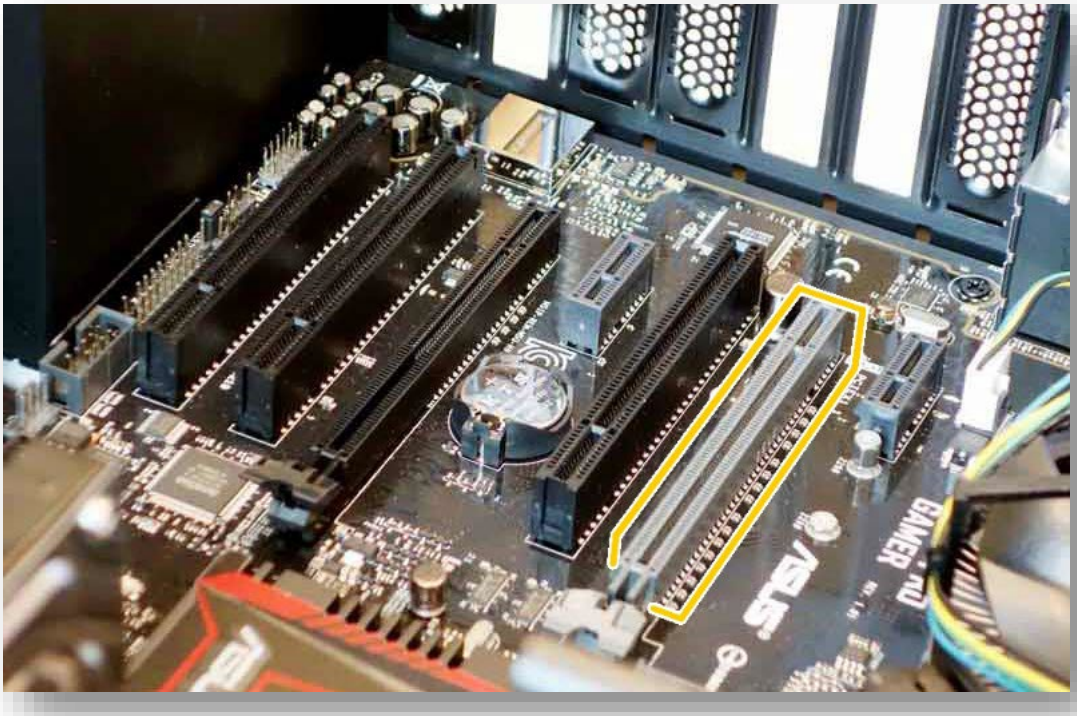
PCI



PCIe x1



PCIe x16



2.1.5.3 Other Factors for Adapter Card Selection

Other Factors for Adapter Card Selection

Before purchasing an adapter card, consider the following questions:

- What are the user's current and future needs?
- Is there an open and compatible expansion slot available?
- What are the possible configuration options?

Graphics Card

- Slot type
- Amount and speed of video RAM (VRAM)
- Graphics Processor Unit (GPU)
- Maximum Resolution

Sound Card

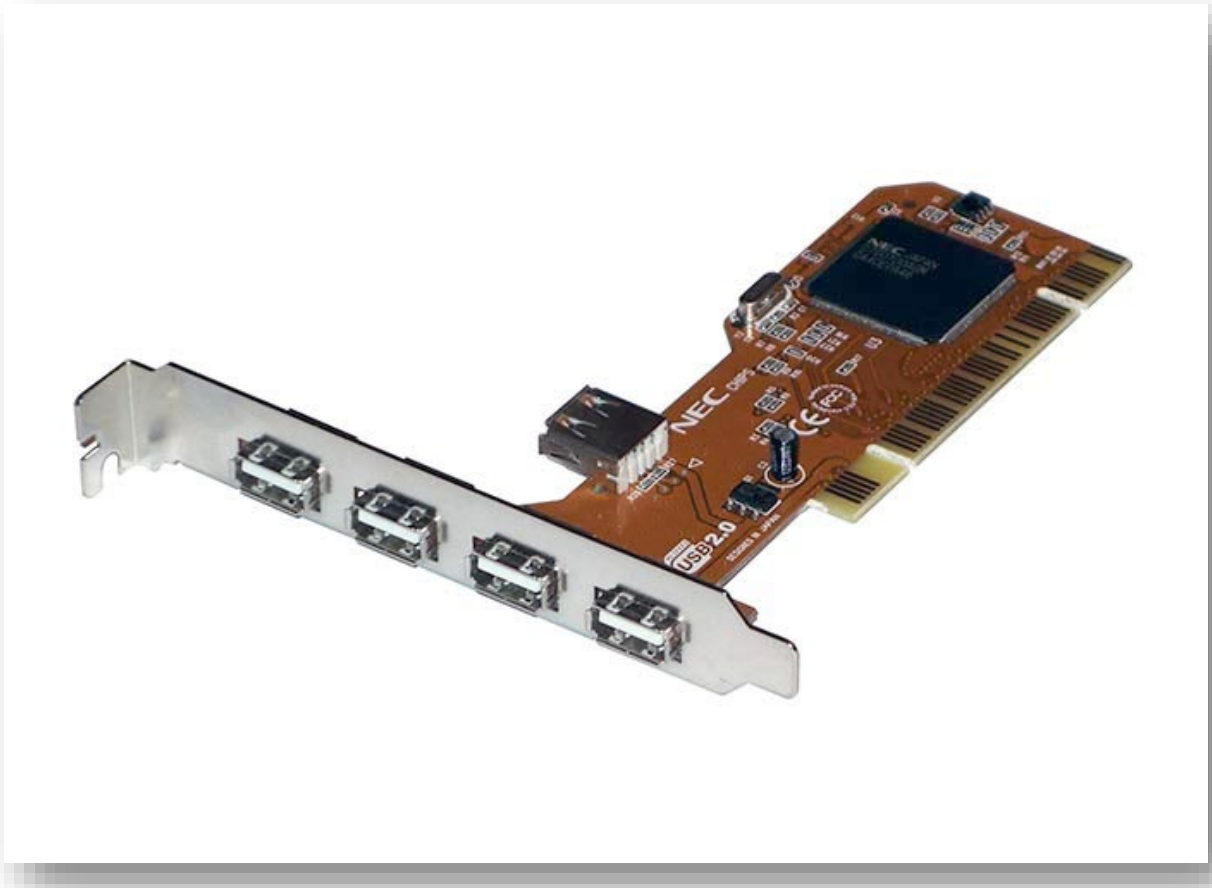
- Slot type
- Digital signal processor (DSP)
- Port and connection types
- Signal-to-noise ratio

Storage Controller Card

- Slot type
- Connector quantity
- Internal or external connectors
- Card size
- Controller card RAM
- Controller card processor
- RAID type

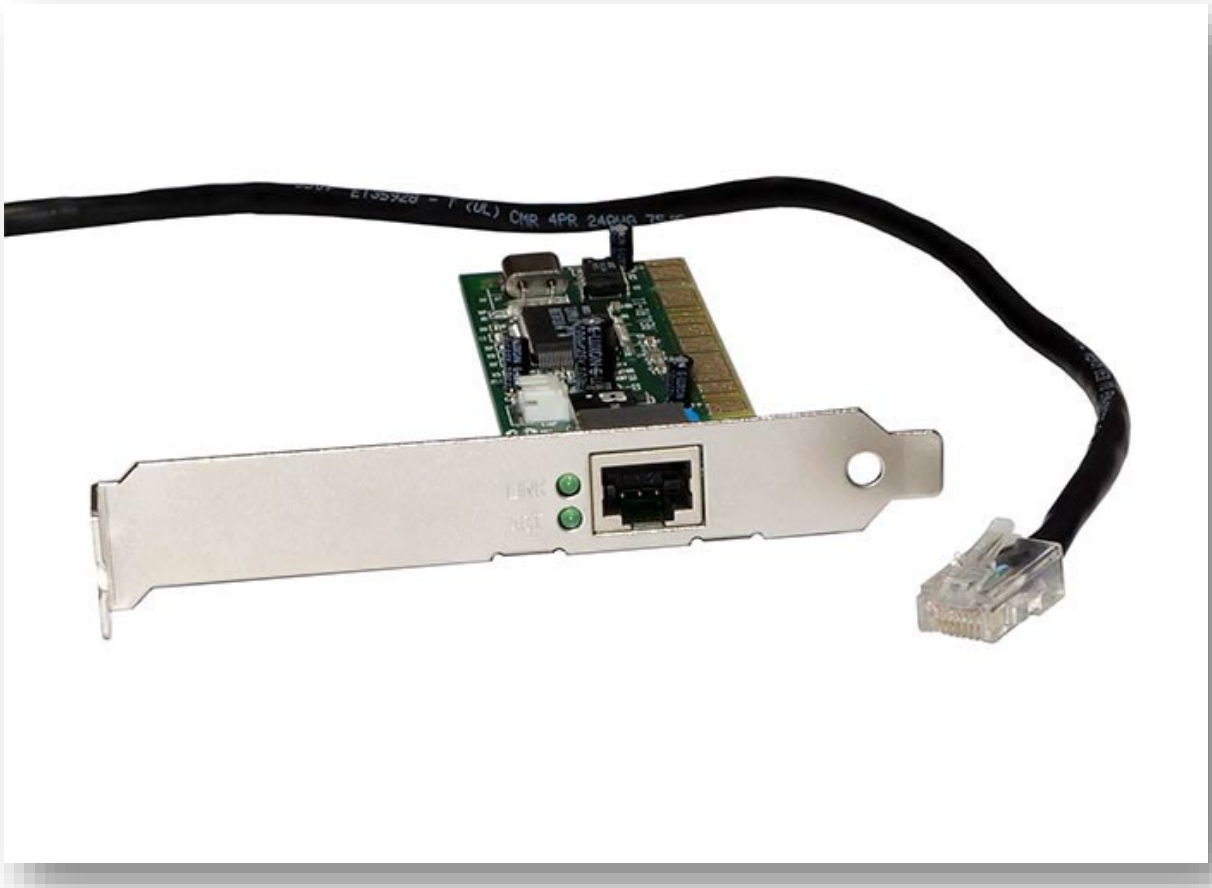
I/O Card

- Slot ratio
- I/O port type
- I/O port quantity
- Additional power requirements



NIC

- Slot type
- Speed
- Connector type
- Wired or wireless connection
- Standards compatibility



Capture Card

- Storage
- Resolution and frame rate
- I/O port
- Format standards
- Input interface types

2.1.5.4 Install the Adapter Cards

Expansion cards are installed into an empty but appropriate slot on a computer motherboard.

For example, a wireless NIC enables a computer to connect to a wireless (Wi-Fi) network. Wireless NICs can be integrated into the motherboard, connected using a USB connector, or installed using a PCI or PCIe expansion slots on the motherboard.

Many video adapter cards require separate power from the power supply using a 6-pin or 8-pin power connector. Some cards may need two of these connectors. If possible, provide some space between the video adapter and other expansion cards. Video adapters create excessive heat, which is often moved away from the card with a fan.

Installation Tip: Research the length of the video card (and other adapter cards) before purchase. Longer cards may not be compatible with certain motherboards. Chips and other electronics may stand in the way of the adapter card when trying to seat them in the expansion slot. Some cases might also limit the size of adapter cards that can be installed. Some adapter cards may come with mounting brackets of different heights to accommodate these cases.

Installation Tip: Some cases have small slots at the bottom of the hole where the cover was removed. Slide the bottom of the mounting bracket into this slot before seating the card.

2.1.5.6 Lab - Install Adapter Cards

Introduction

In this lab, you will install a NIC, a wireless NIC, and a video adapter card.

Recommended Equipment

- Computer with power supply, motherboard, and drives installed
- NIC
- Wireless NIC
- Video adapter card
- Adapter card screws
- Antistatic wrist strap and antistatic mat
- Tool kit
- Motherboard manual

Instructions

Step 1: Install the wired NIC.

Question:

What type of expansion slot is compatible with the NIC?

a. Locate a compatible expansion slot for the NIC on the motherboard.
b. Remove the slot cover from the back of the case, if necessary.
c. Align the NIC to the expansion slot.
d. Press down gently on the NIC until the card is fully seated.
e. Secure the NIC by attaching the PC mounting bracket to the case with a screw.

Step 2: Install the wireless NIC.

Question:

What type of expansion slot is compatible with the wireless NIC?

a. Locate a compatible expansion slot for the wireless NIC on the motherboard.
b. Remove the slot cover from the back of the case, if necessary.
c. Align the wireless NIC to the expansion slot.
d. Press down gently on the wireless NIC until the card is fully seated.

Secure the wireless NIC by attaching the PC mounting bracket to the case with a screw.

Step 3: Install the video adapter card.

Question:

What type of expansion slot is compatible with the video adapter card?

.

a. Locate a compatible expansion slot for the video adapter card on the motherboard.
b. Remove the slot cover(s) from the back of the case, if necessary.
c. Align the video adapter card to the expansion slot.
d. Press down gently on the video adapter card until the card is fully seated.
e. Secure the video adapter card by attaching the PC mounting bracket(s) to the case with a screw. This lab is complete. Please have the instructor verify your work.

2.1.6 Select Additional Storage

2.1.6.1 Select a Media Reader

Many digital devices such as cameras, smart phones, and tablets use media cards to store information, music, pictures, videos, data, and more.

Several media card formats have been developed over the years including:

- **Secure digital (SD)** - SD cards were designed for use in portable devices such as cameras, MP3 players, and laptops. SD cards can hold as much as 2 TB of data.
- **MicroSD** – This is a much smaller version of SD, commonly used in smartphones and tablets.
- **MiniSD** – A version of SD between the size of an SD card and a microSD card. The format was developed for mobile phones.
- **CompactFlash** - CompactFlash is an older format, but still in wide use because of its high speed and high capacity (up to 128 GB is common). CompactFlash is often used as storage for video cameras.
- **Memory Stick** – Created by Sony Corporation, Memory Stick is a proprietary flash memory used in cameras, MP3 players, hand-held video game systems, mobile phones, cameras, and other portable electronics.
- **xD** – Also known as Picture Card, it was used in some digital cameras.

SD

MicroSD

128GB ULTRA SPEED
PROFESSIONAL MEMORY CARD
90MB/s
CLASS 10
MADE IN JAPAN

MiniSD

CompactFlash

It is useful to have an internal or external device that can be used to read or write to media cards. When purchasing or replacing a media reader, ensure that it supports the types of media cards that will be used.

The following figure displays an external media card reader and lists factors to consider when purchasing a media reader.

Choose the correct media reader based on your customer's current and future needs. For example, if a customer needs to use multiple types of media cards, a multiple format media reader is needed.

New Media Reader Factors

- Media cards supported
- Internal or external
- Size
- Connector type

2.1.6.2 Select External Storage

External storage offers portability and convenience when working with multiple computers. External USB flash drives, sometimes called thumb drives, are commonly used as removable external storage. External storage devices connect to an external port using USB, eSATA, or Thunderbolt ports.

The figure displays an external flash drive and lists factors to consider when purchasing an external storage solution.

Choose the correct type of external storage for your customer's needs. For example, if your customer needs to transfer a small amount of data, such as a single presentation, an external flash drive is a good choice. If your customer needs to back up or transfer large amounts of data, choose an external hard drive.

New External Storage Factors

- Port type
- Storage capacity
- Speed
- Portability
- Power requirements

2.1.7 Install the Cables

2.1.7.1 Video Demonstration - Connect the Internal Power Cables

Hello everyone, this is our install the power connector video. This is going to be a two part video. The first part, we're going to install the power connectors on the motherboard.

Step one, we need to align our 24-pin connector with the socket on the motherboard. There's our socket and here's our 24-pin connector. With step one, aligning it means we need this clip to connect on the outside of that connector. So, we can go ahead and we can align it with that connector.

Now, that it's aligned, step two, we're going to gently press down on the connector until that clip locks into place. As we press down, we hear it click into place.

Step three, we need to align our 4-pin power connector for auxiliary power in the motherboard, which, we'll see here, also has a clip, with its corresponding connector on the motherboard. To align it, I'll just drop it in on top and then, step four, we're going to gently press down on that connector until it clicks into place.

And now, it clicked into place. Step five, we need to take our CPU fan with its power connector, right here, and we need to align this correctly, which, we'll see a little, here, you'll align that correctly with the actual CPU fan slot on the motherboard, which, is right here.

Step six, we're going to gently press down on it and put it in place. It doesn't click, it just slides in and we are done.

In part two of our video we're going to install the power connector for our SATA hard drive. Now, this is our 2 1/2 inch solid state hard drive. On the back, we're going to have a data port and a power port. So, we can take a zoom in here and see a closer view. The larger port, here, is going to be the power connector and this is going to be our 15-pin SATA power connector.

So, step one, we're going to take our power connector that's going to attach to the drive, and here's what it looks like, right here, and we can see it's keyed in a specific way, so, you cannot install it upside-down, and we need to align it correctly with the SATA hard drive. When we have it aligned correctly, we can take it and line it up, right here, and step two, is we're going to gently push it in until it's fully seated.

Awesome. Now, that we have the SATA 15-pin power connector installed, we're going to install the power connector for our case fan. This is going to be a 3-pin power connector that we'll connect to on the motherboard. The power connector looks exactly like this. It's got a spot for three pins. The connector on the motherboard that we're going to hook it to is right below, here, and it is brown.

We'll zoom in and take a closer look at that power connector. So, as you see, right here, that's going to be the 3-pin power connector and we're going to connect it in.

Step one, we need to align the power connector to the motherboard. Again, this power connector has a slot just like we saw previously for the CPU fan.

So, step two, we're going to press it in gently, now, that we have it aligned. And that is what it looks like when it is installed correctly.

Thank you for watching our installing the power connectors video.

2.1.7.3 Video Demonstration - Connect the Internal Data Cables

Hello everyone, welcome to our install the data connectors video. First, we want to take a look at our motherboard and find those SATA data connectors. They're down here, I've got four of them. Also, on my solid state hard drive, I've got the SATA power connector that we installed previously, but I removed it so we can see that SATA data connector which is the smaller of the two on this side.

So to get started, step one, we need to align our SATA data cable and it's notched to fit exactly down below, so we'll align it. Then after it's aligned, you can just gently push it in and it will click into place.

Step two, we'll take our right angle SATA data cable here and we're going to connect it with its corresponding connector on our hard drive. So we line it up and we can press it in. And it clicks into place, awesome.

Thank you for watching our connecting the data cables video.

2.1.7.4 Lab - Install Internal Cables

Introduction

In this lab, install the internal power and data cables in the computer.

Recommended Equipment

- Computer with power supply, motherboard, drives, and adapter cards installed
- Hard disk drive data cable
- Optical drive data cable
- Antistatic wrist strap and antistatic mat
- Tool kit
- Motherboard manual

Instructions

Step 1: Connect the motherboard power supply connector.

a. Align the motherboard power supply connector to the socket on the motherboard.

b. Gently press down on the connector until the clip clicks into place.

Step 2: Connect the auxiliary power connector.

a. Align the auxiliary power connector to the auxiliary power socket on the motherboard.

b. Gently press down on the connector until the clip clicks into place.

Note: This step is necessary only if your computer has an auxiliary power connector.

Step 3: Connect the internal disk drive power connectors.

Plug a power connector into the hard disk drive and the optical drive.

Step 4: Connect the video adapter card power cable.

Plug the PCIe power connector to the video adapter card.

Note: This step is necessary only if your video adapter card has a PCIe power connector.

Step 5: Connect the fan power connector.

Connect the fan power connector into the appropriate fan header on the motherboard.

Note: This step is necessary only if your computer has a fan power connector.

Step 6: Connect the hard disk data cable.

a. Align and plug the hard disk drive data cable into the motherboard connector.

b. Align and plug the other end of the hard disk drive data cable into the hard disk drive connector.

Note: SATA cables are keyed to ensure correct orientation with the connector.

2.1.7.5 Video Demonstration - Install the Front Panel Cables

Hello everyone. Here we get to install front panel connectors. This is going to include audio connectors, as well as power switch, reset switch, hard drive activity lights.

So to get started, we're going to use a different board, just because the other board was more proprietary for a specific vendor. This will be better. To start it off, what we're going to see here is that down in the left corner, we'll zoom in on this in a little bit, we're going to have our front panel audio. And down to the bottom right corner, we're going to have front panel connectors.

So first we're going to take a look at the front panel audio. So we have a zoomed view of the front panel pins for our audio connector. And what you can see here, is that we have nine pins. It looks like one of them is missing, but it's not missing. That's just because it's a keyed slot. If we a look at actual connector that's coming off of the front panel that we're going to plug in, it's this.

This is a HD audio connector. And the HD audio connector, if we take a look at the actual holes, look at that. It's got that same keyed format, we've got that one that's going to be missing, and you know, the orientation for the motherboard. So all we need to do, is slide this back onto those pins, and we'll have this up and running. So we've got our audio connector connected to our motherboard and now we're going to move over to the front panel.

So let's take a closer look at the front panel connectors on the motherboard. Here they are at the bottom right corner. What we'll see here is power LED, as well as hard drive LED, power switch, speaker, which is not your normal speaker. That's your errors, bios, and boot up issues. And a reset switch. What we need to do, is take these connectors that are coming off with the front panel of our tower, and we hook them accordingly.

Well how do you know what goes where and what orientation? That's where you consult your manual.

Bing! My manual is here. So you can see my diagram for how I need to connect these, and that's what we're going to do next. So what we'll do first, is we're going to take the power LEDs, and that's going to be these two right here. And we'll take these power LEDs and put them in the correct orientation.

According to our picture, the positive one is going to go on the left to this pin and the negative one will go here on the next pin over on the right. So, I'll do that. And what you'll notice is, there is a gap between those two, and that's okay. That's a blank slot, again it's keyed.

Next we want to do, is go ahead and do the power switch. That power switch is, hiding underneath here, there we go. This is the power switch. And the power switch is going to go right here, where you see the power switch button, PWRSW. Same thing for this, we don't have to worry about a positive, negative, we just need to drop this thing on that power switch. Power switch is installed, next we're going to do the reset.

So, we'll find the reset switch, which is this one right here, and reset needs to go on these two, as it shows in our diagram. The reset switch is now installed.

And lastly, we're going to set up and do the hard drive LED. Hard drive LED, according to our diagram, is the bottom left corner. And our front panel connectors are now installed. So

it's all installed, that's awesome. If you had any USB connectors, we'd pop them in and plug them straight into these keyed USB ports, it would be fine for those as well. My system does not have those for this motherboard, and this case that I'm utilizing, so we don't have to drop those in.

Now, take care and practice putting these connectors on, and make sure you take the time to find the manual, so you know how to do it properly. You're one step closer to being an IT professional and doing one of the hardest parts of hooking up a motherboard inside of a computer case.

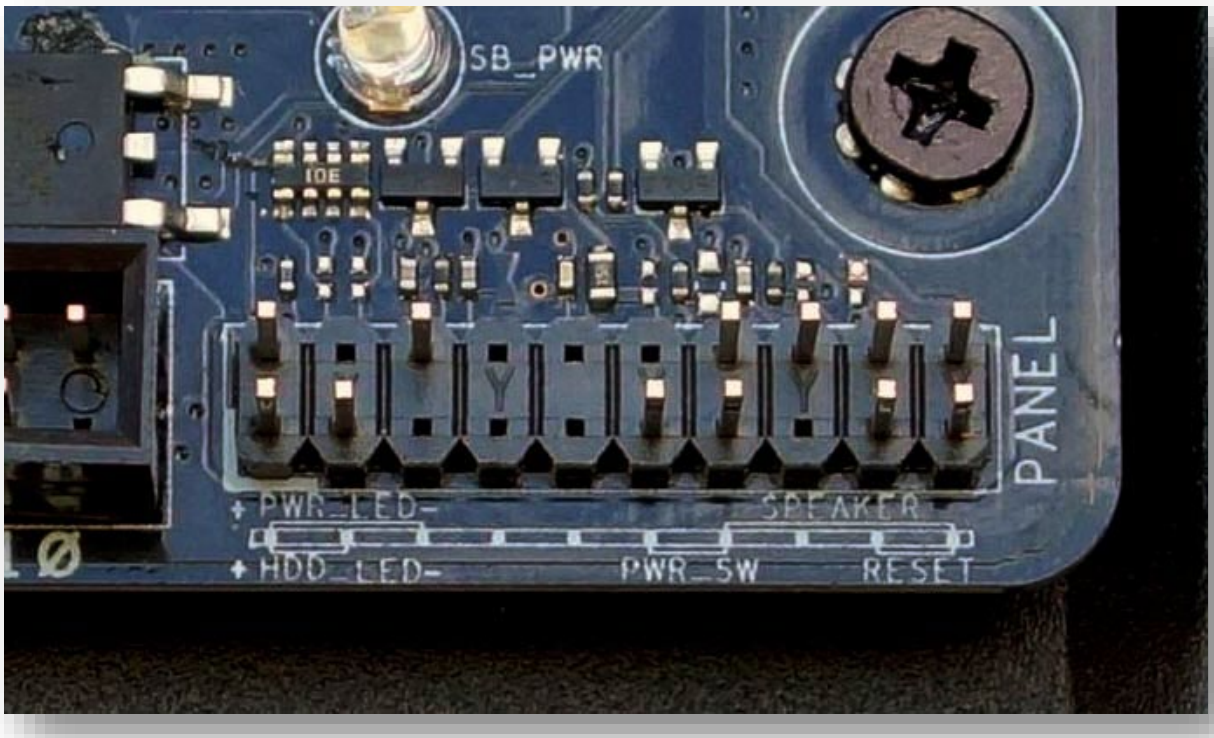
2.1.7.6 Install the Front Panel Cables

A computer case typically has a power button and visible activity lights on the front of the case. The case will include front panel cables that must be connected to a common system panel connector on a motherboard.

Front Panel Connectors

System Panel Connector

Writing on the motherboard near the system panel connector shows where each cable is connected.



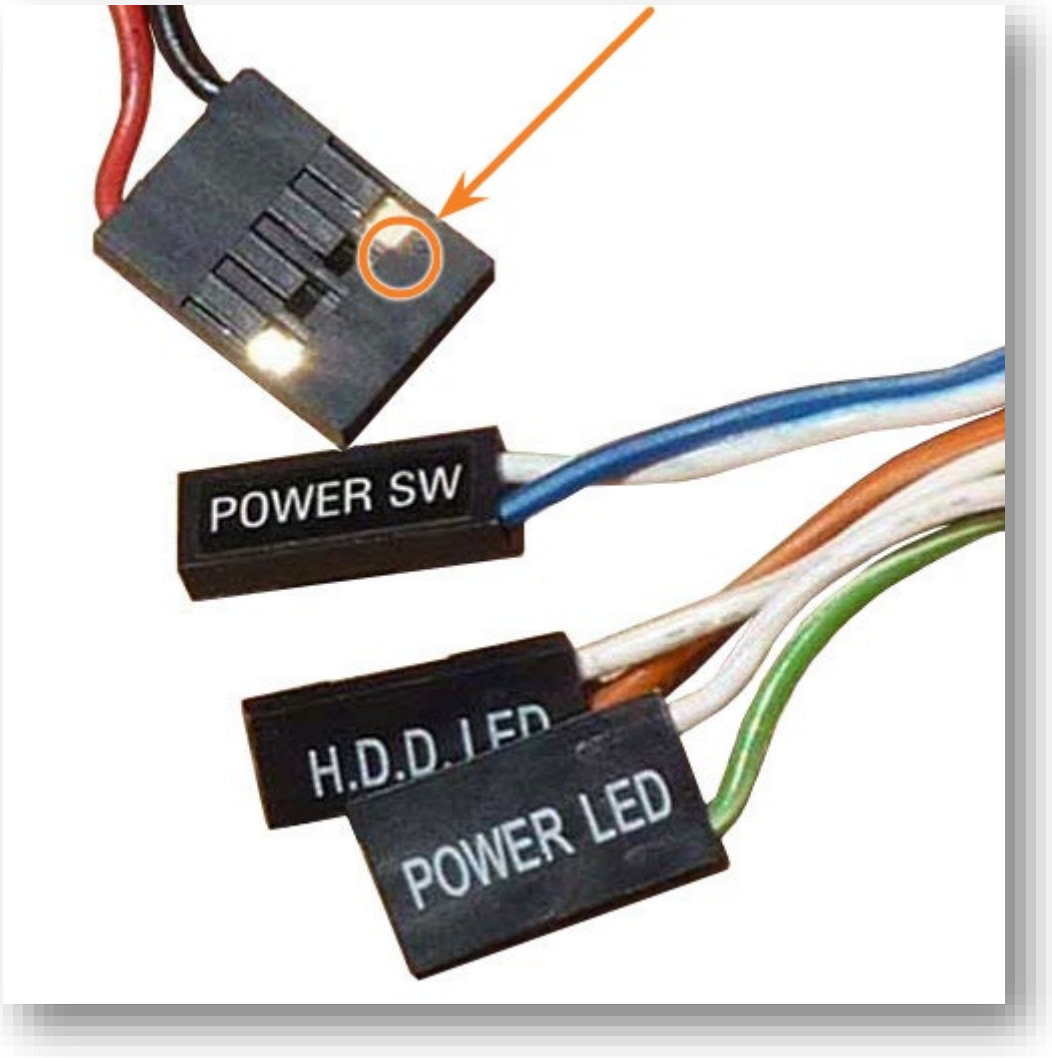
System panel connectors include:

- **Power Button** - The power button turns the computer on or off. If the power button fails to turn off the computer, hold down the power button for several (i.e., 5 or more) seconds.
- **Reset Button** - The reset button (if available) restarts the computer without turning it off.
- **Power LED** - The power LED remains lit when the computer is on, and often blinks when the computer is in sleep mode.
- **Drive Activity LEDs** - The drive activity LED remains lit or blinks when the system is reading or writing to hard drives.
- **System Speaker** - The motherboard uses a case speaker (if available) to indicate the computer's status. For example, one beep indicates that the computer started without problems. If there is a hardware problem, a series of diagnostic beeps is issued to indicate the type of problem. It is important to note that the system speaker is not the same as the speakers the computer uses to play music and other audio. The system speaker cable typically uses four pins on the system panel connector.
- **Audio** - Some cases have audio ports and jacks on the outside to connect microphones, external audio equipment such as signal processors, mixing boards, and instruments. Special audio panels can also be purchased and connected directly to the

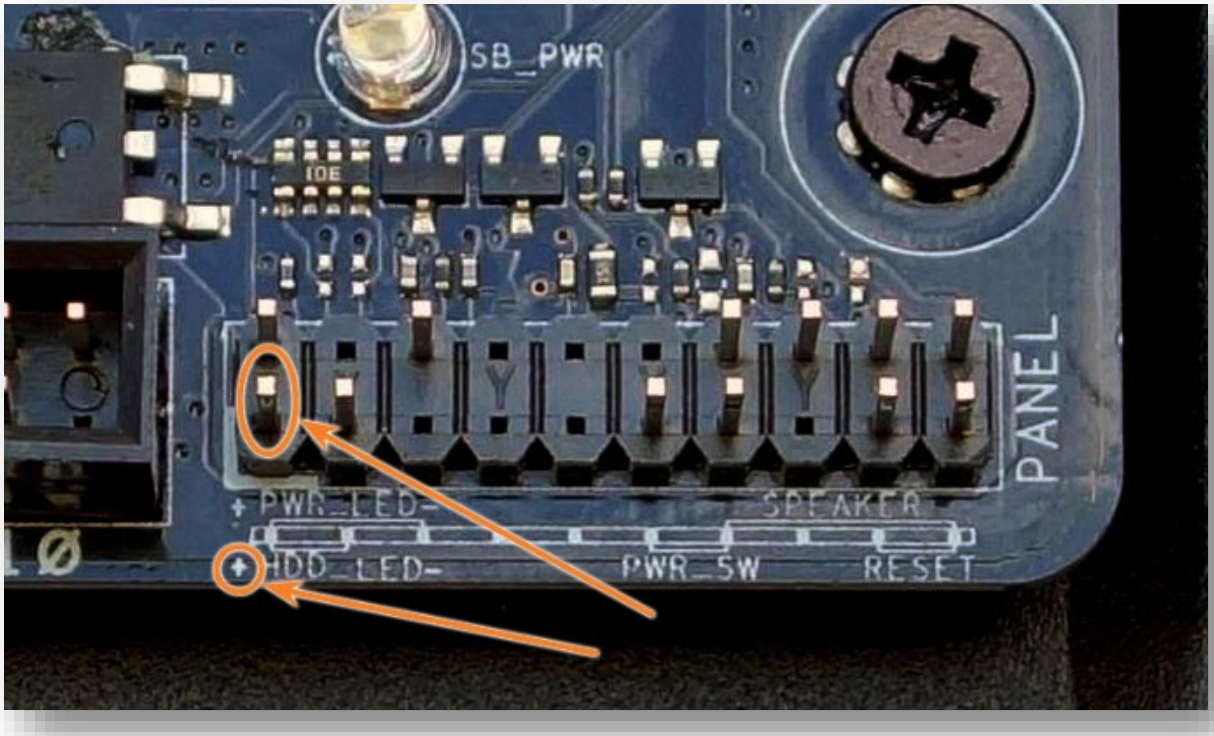
motherboard. These panels can install into one or more external drive bays, or be standalone panels.

System panel connectors are not keyed. However, each front panel cable usually has a small arrow indicating pin 1, and each pair of LED pins on the motherboard system panel connector has pin 1 marked with a plus sign (+).

Pin 1 Arrow Indicator



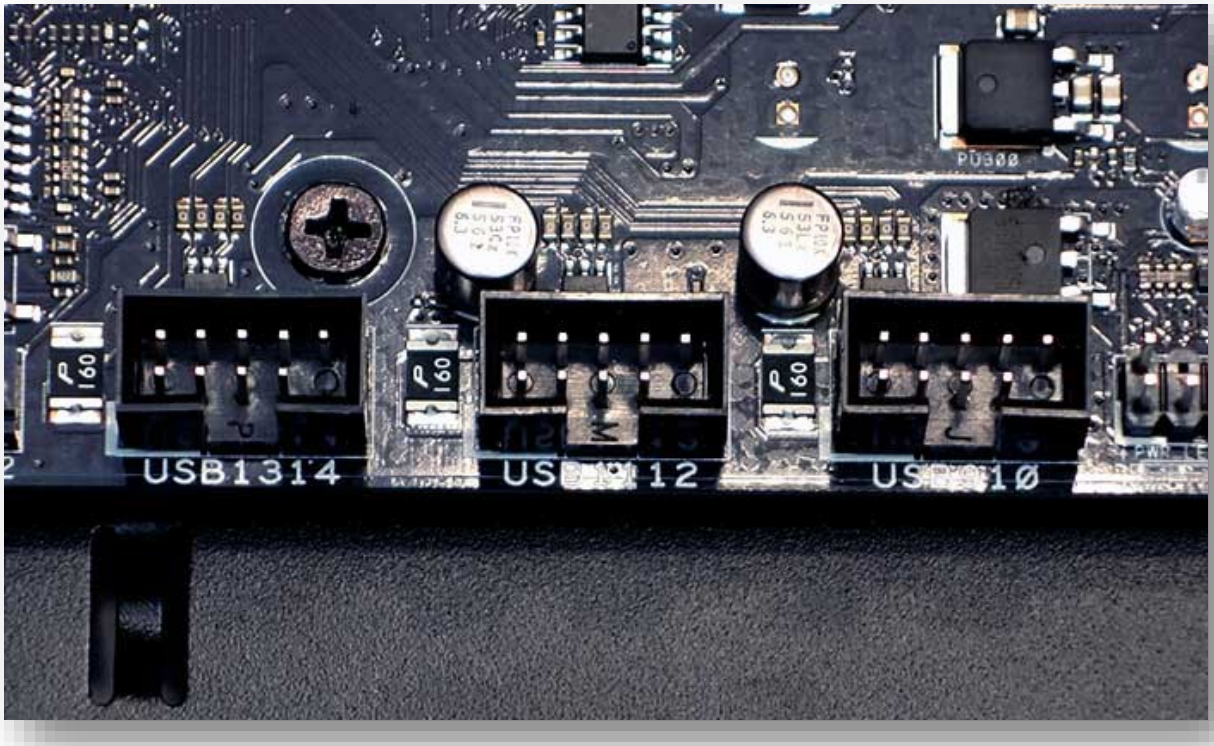
System Panel Connector Pin 1 Indicator



Note: The markings on your front panel cables and system panel connectors may be different than what is shown as no standards for labeling the case cables or the system panel connectors are defined. Always consult the motherboard manual for diagrams and additional information about connecting front panel cables.

New cases and motherboards have USB 3.0 or may even have USB 3.1 capabilities. The USB 3.0 and 3.1 motherboard connector is similar in design to a USB connector, but has additional pins. USB connector cables are often 9 or 10 pins arranged in two rows. These cables connect to USB motherboard connectors.

USB Motherboard Connectors



Internal USB Connector

This arrangement allows for two USB connections, so USB connectors are often in pairs. Sometimes the two connectors are together in one piece, as shown in the figure, and can be connected to the entire USB motherboard connector. USB connectors can also have four or five pins or individual groups of four or five pins. Most USB devices only require the connection of four pins. The fifth pin is used to ground the shielding of some USB cables.

CAUTION: Make sure that the motherboard connector is marked USB. FireWire connectors are very similar. Connecting a USB cable to a FireWire connector will cause damage.

The following table provides connecting notes on various front panel connections.

Front Panel Cable Connection Specifics

Front Panel	**Connection Specifics**
Power Button	Align pin 1 of the two-pin front panel power button cable with the power button pins on the motherboard.

Reset Button	Align pin 1 of the two-pin front panel reset button cable with the reset button pins on the motherboard.
Power LED	Align pin 1 of the front panel power LED cable with the power LED pins on the motherboard.
Drive Activity LED	Align pin 1 of the front panel drive activity cable with the drive activity pins on the motherboard.
System Speaker	Align pin 1 of the front panel system speaker cable with the system speaker pins on the motherboard.
Audio Cables	Due to the specialized function and variety of the hardware, consult the motherboard, case, and audio panel documentation for specific instructions.
USB	Align pin 1 of the USB cable with the USB pins on the motherboard.

Generally, if a button or LED does not function, the connector is incorrectly oriented. To correct this, shut down the computer and unplug it, open the case, and turn the connector around for the button or LED that does not function. To avoid wiring incorrectly, some manufacturers include a keyed pin extender that combines multiple front-panel cables (i.e., power and reset LEDs) connectors into one connector.

Installation Tip: The panel connector and case cable ends are very small. Take pictures of them to locate pin 1. Because space in the case can be limited at the end of assembly, a part retriever can be used to plug the cables into the connectors.

2.1.7.8 Lab - Install the Front Panel Cables

Introduction

In this lab, install the front panel cables in the computer.

Recommended Equipment

- Computer with power supply, motherboard, drives, and adapter cards installed
- Antistatic wrist strap and antistatic mat
- Tool kit
- Motherboard manual

Instructions

Step 1: Connect the reset switch connector.

Gently press down on the reset switch connector until the pins are fully inserted.

Step 2: Connect the power switch connector.

Gently press down on the power switch connector until the pins are fully inserted.

Step 3: Connect the power LED connector.

Gently press down on the power LED connector until the pins are fully inserted.

Step 4: Connect the HDD LED connector.

Gently press down on the HDD LED connector until the pins are fully inserted.

Step 5: Connect the speaker connector.

Gently press down on the speaker connector until the pins are fully inserted.

Step 6: Connect the USB and front audio jacks.

If your case also has front USB and front audio jacks, gently press down on the connector until the clip clicks into place or the pins are fully inserted.

Step 7: Verify the Connections.

Note: If any LED or switch does not work when the computer is first started, remove the connector for that item, turn it around, and reconnect it.

2.1.7.9 Video Demonstration - Complete the Computer Assembly

Hello everyone. In this video, we're going to reassemble our case and then we're going to install our external cables. To get started, we have the front of our tower here, and we'll put on our front cover.

Now remember, the front cover just had these locking clips on the side, so we just need to line it up, and all we need to do is push down in the corners. And now, the front case is locked. We've got our USB ports, our headphone and our mic port. Also on the front here, we also have our DVD disc drive that we installed. I can turn this on its face. And now, we can do our external cables.

So for this part, I'll take off my anti-static wrist strap and I can take my power cord and I can just slide the plug in here. And you shouldn't have to force any one of these cables as you install the cables to the back of your tower. I've got a USB for my keyboard. These you do have to align, so take a close look regarding how you need to align it. You'll see the correct end to slide in. And I have another USB. So this is my keyboard and mouse combo. And again, we'll take a look at the alignment of the USB and plug it in.

Also, at this time, I have my graphics cable. For me, I have a DVI connection. The DVI is going to go to my white port here on my graphics card we installed. So I'll plug that in. And we've got two screws on that. We can just easily screw it until it's snug. You don't need to over-tighten these. It's not going to fall out.

Lastly, I have an audio cable and I have my network jack. I'll plug in my network jack to my Ethernet port and then my audio cable is green for my speakers out. And I'll plug that into my green speaker out port. Our external cables are installed.

Last thing, we take a look at the side. It's still open. We need to close it up with the cover. With the cover, it's just going to slide on. You can see the slots here along the top that we're going to lock it into. We're just going to rest it in. You can shift it and feel it just slide into place. And then there should be no force really needed here, just slowly slide it forward. Then I have my locking screw, which now I can just close that by hand, and then I can give it a little bit of a snug tighten. And again, we don't need to over-tighten that. And now we're done. Our case is put back together. It is ready to go. Thank you for watching our video.

2.1.7.11 Lab – Complete the Computer Assembly

Introduction

In this lab, you will install the side panels and the external cables on the computer.

Recommended Equipment

- Computer with power supply, motherboard, drives, and adapter cards installed, and internal cables connected
- Monitor cable (HDMI, DVI, or VGA)
- Keyboard
- Mouse
- Network cable
- Wireless antenna
- Power cable
- Tool kit
- Motherboard manual

Instructions

Step 1: Attach the side panels.

a. Attach the side panels to the computer case.

b. Secure the side panels to the computer using the panel screws.

Step 2: Attach the monitor cable.

a. Attach the monitor cable to the video port.

b. Secure the cable by tightening the screws on the connector.

Step 3: Attach the keyboard cable.

Plug the keyboard cable into the USB or PS/2 keyboard port.

Step 4: Attach the mouse cable.

Plug the mouse cable into the USB or PS/2 mouse port.

Step 5: Attach the Ethernet cable.

Plug the Ethernet cable into the Ethernet port.

Step 6: Attach the wireless antenna.

Connect the wireless antenna to the antenna connector.

Step 7: Attach the power cable.

Plug the power cable into the power socket of the power supply.

Step 8: Verify connections.

This lab is complete. Please have the instructor verify your work.

2.2.1 Conclusion

2.2.1.1 Chapter 2: PC Assembly

In this chapter you learned that assembling computers is often a large part of a technician's job and that as a technician, you must work in a logical, methodical manner when working with computer components. For example, the choice of motherboard and external components influences the selection of the case and power supply and the motherboard form factor must be matched with the correct type of computer case and power supply.

You learned that PC power supplies convert AC input to DC output voltages. Power supplies typically provide voltages of 3.3V, 5V, and 12V to power the various internal components of the computer and that the power supply must have the proper connectors for the motherboard and the various types of devices to be powered.

After learning about power supplies, you installed a power supply as well as other internal components including a CPU and RAM. You learned that when you select a motherboard it must support the CPU, RAM, video adapter, and other adapter cards and that the socket and chipset on the motherboard must be compatible with the CPU. The motherboard sockets may be designed to support Intel CPUs, which support an LGA architecture, or AMD CPUs which support a PGA architecture.

In addition to learning about CPU architectures, you also learned that when selecting new RAM, it must be compatible with the motherboard and that the speed of the RAM must be supported by the chipset. You then performed labs where you installed a CPU, a heat sink/fan assembly, and RAM modules on the motherboard. You also installed the motherboard assembly into the computer case.

Next, you learned about the various types of storage drives, such as internal drives, external drives, hard-disk drives, solid-state drives, and optical drives and the factors to consider when selecting the appropriate drive. You then installed drives in the computer case.

Finally, you learned about adapter cards, which are also called expansion cards, or add-on cards. There are many types of adapter cards and each is designed for a specific task and to

add extra functionality to a computer. The chapter covered graphics cards, sound cards, storage controllers, I/O cards, and NICs. These adapter cards are inserted into two types of expansion slots on a motherboard: PCI and PCIe. At the end of the chapter, there were labs where you installed an adapter card, connected the appropriate internal power cables, front panel connectors, and performed final computer assembly.